

**AMENDMENTS TO THE SPECIFICATION**

**IN THE ABSTRACT OF THE DISCLOSURE:**

Replace the Abstract of the Disclosure currently of record with the attached new Abstract of the Disclosure.

IN THE SPECIFICATION:

Page 1

Immediately below the title of the invention, insert the following new section:

CROSS REFERENCE TO RELATED APPLICATION

This Nonprovisional application claims priority under 35 U.S.C. § 119(a) on Patent Application No. 2002-319572 filed in Japan on November 1, 2002, the entire contents of which are hereby incorporated by reference.

Please replace paragraph [0003] with the following amended paragraph:

**[0003]** Protection against an overcurrent by means of an overcurrent protection circuit is realized in the following manner. According to one method, called the shut-down method, when a switching power supply apparatus enters a predetermined overcurrent state, switching operation is stopped, and, even when the overcurrent state is cancelled, switching operation is not restarted automatically, but it is only when the power to the switching power supply apparatus is turned ~~first-off~~off first and then on that the switching power supply apparatus restarts switching operation. According to another method, called the automatic recovery method,

canceling the overcurrent protection state causes the switching power supply apparatus to restart switching operation automatically. Which of these methods to adopt is determined at the time of designing a switching power supply apparatus according to the characteristics of the electronic appliance that is fed with power by the switching power supply apparatus and the user's preference.

Pages 7-8

Please replace paragraph [0023] with the following amended paragraph:

**[0023]** This excessively large current is detected by the output current detection circuit 18, which then short-circuits together the cathode of the photodiode ~~13a~~113a and the negative output line L6. This causes the current through the photodiode ~~13a~~113a to increase, and information on this increase in the current is fed, in the form of a feedback signal, through the phototransistor 13b to the switching control circuit 14.

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Please replace paragraphs [0025] and [0026] with the following amended paragraphs:

**[0025]** Specifically, in the period from the time point t0 to the time point t1, when the voltage between the node between the

positive output line L5 and the anode of the photodiode ~~13a~~113a and the point on the negative output line L6 at which the output current detection circuit 18 is connected thereto decreases, the currents that flow through the photodiode ~~13a~~113a and the phototransistor 13b decrease, and therefore the switching control circuit 14 controls the switching operation of the FET 7 in the direction in which the output power of the switching power supply apparatus increases commensurately with the decrease in those currents.

**[0026]** On the other hand, when the voltage between the node between the positive output line L5 and the anode of the photodiode ~~13a~~113a and the point on the negative output line L6 at which the output current detection circuit 18 is connected thereto increases, the currents that flow through the photodiode ~~13a~~113a and the phototransistor 13b increase, and therefore the switching control circuit 14 controls the switching operation of the FET 7 in the direction in which the output power of the switching power supply apparatus decreases commensurately with the increase in those currents. Thus, the switching power supply apparatus outputs power of which the level is such that a proper balance is achieved among these conflicting factors.

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Please replace paragraph [0033] with the following amended paragraph:

**[0033]** When the positive and negative output terminals 10 and 11 cease to be short-circuited, the output current detection circuit 18 cancels the short-circuiting between the cathode of the photodiode ~~13a~~113a of the photocoupler ~~13~~113 and the negative output line L6. Thus, when a switching operation period (for example, the period from the time point t2 to the time point t3, or the period from a time point t4 to a time point t5 (the time point t5 is not shown in the figure), or any of the succeeding similar switching operation periods) starts, only the current to the shunt regulator 12a of the output voltage detection circuit 12 flows through the photodiode ~~13a~~113a, and this causes the switching power supply apparatus to enter the steady state, in which its output voltage stabilizing function works.

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Please replace paragraph [0035] with the following amended paragraph:

**[0035]** Now, the cause of ~~this~~the noted problem will be explained. In this conventional switching power supply apparatus, the capacitor 17 needs to be given a sufficiently high capacitance so that, when the switching power supply apparatus starts to start up, the charge voltage Vcc does not become lower than the minimum

operating voltage of the switching control circuit 14, for example, during the period from the time point T1 to the time point T2 shown in Figs. 11A to 11C.

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Please replace paragraph [0041] with the following amended paragraph:

**[0041]** In particular, the voltage between the node between the positive output line L5 and the anode of the photodiode ~~13a~~113a and the point on the negative output line L6 at which the output current detection circuit 18 is connected thereto becomes equal to or higher than the forward voltage drop across the photodiode ~~13a~~113a, and a current equal to this voltage divided by the resistance of the positive and negative output lines L5 and L6 flows through the positive and negative output lines L5 and L6. This resistance is approximately close to zero ohms, and thus produces a short-circuited state. As a result, an excessively large current flows through the diode 8 provided on the positive output line L5, causing the diode 8 to become extremely hot.

Page 14

Please replace paragraph [0044] with the following amended paragraph:

**[0044]** Here, to ~~make~~ simplify the explanations ~~simple~~, it is assumed that a current  $I_k$  is constantly fed from the capacitor 5 through the start-up resistor 15 to the capacitor 17, and that the switching control circuit 14 consumes a current  $I_s$  in a switching operation period (in Figs. 12A to 12C, the period from the time point  $t_2$  to the time point  $t_3$ , or the period from the time point  $t_4$  to the time point  $t_5$  (not shown)). Moreover, to make calculations simple, it is assumed that the switching control circuit 14 consumes zero amperes in a no-switching-operation period (in Figs. 12A to 12C, the period from the time point  $t_1$  to the time point  $t_2$ , or the period from the time point  $t_3$  to the time point  $t_4$ ).

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Please replace paragraph [0082] with the following amended paragraph:

**[0082]** One end of a secondary coil 6b of the transformer 6 is connected through a diode 8 to a positive output line L5, and the other end of the secondary coil 6b is connected to a negative output line L6. Between the positive and negative output lines L5 and L6, there are connected a capacitor 9, a serial circuit composed of a photodiode ~~13a~~ 113a of the photocoupler ~~13~~ 113, a resistor 12b, and a shunt regulator 12a, and a serial circuit composed of resistors 12d and 12c. The node between the resistors 12d and 12c is connected to

the monitoring terminal of the shunt regulator 12a. The shunt regulator 12a and the resistors 12b, 12c, and 12d together constitute an output voltage detection circuit 12.

Page 27-28

Please replace paragraph [0083] with the following amended paragraph:

**[0083]** The positive output line L5 is connected to a positive output terminal 10, and the negative output line L6 is connected through an output current detection circuit 18 to a negative output terminal 11. The control terminal of the output current detection circuit 18 is connected to the node between the photodiode ~~13a~~113a and the resistor 12b. The output current detection circuit 18 may be provided between the positive output line L5 and the positive output terminal 10.

Page 28-29

Please replace paragraph [0086] with the following amended paragraph:

**[0086]** The voltage between the positive and negative output lines L5 and L6 is divided by a voltage division circuit constituted by the serially connected resistors 12d and 12c, and the divided voltage is fed, as a monitored voltage, to the monitoring terminal



of the shunt regulator 12a. The shunt regulator 12a compares the monitored voltage fed to the monitoring terminal thereof with a reference voltage previously set therein, and feeds a current commensurate with the result of the comparison to the photodiode 13a of the photocoupler ~~13-113~~ to make the photodiode ~~13a-113a~~ emit light.

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Please replace paragraph [0087] with the following amended paragraph:

**[0087]** The light from the photodiode ~~13a-113a~~ is received by the phototransistor 13b of the photocoupler 13, and the phototransistor 13b feeds, as a feedback signal, a voltage commensurate with the result of the aforementioned comparison to the feedback input terminal of the switching control circuit 14. The switching control circuit 14 controls, according to the feedback signal thus fed thereto, the switching operation of the FET 7 so as to stabilize the output voltage of the switching power supply apparatus.

Pages 29-30

Please replace paragraph [0089] with the following amended paragraph:

[0089] The output current detection circuit 18, which is connected between the negative output line L6 and the negative output terminal 11, compares the current on the negative output line L6 with a reference current previously set therein. When the current on the negative output line L6 is larger than the reference current, the output current detection circuit 18 short-circuits together the cathode of the photodiode ~~13a~~113a of the photocoupler ~~13~~113 and the negative output line L6. This increases the current through the photodiode ~~13a~~113a. In a case where the output current detection circuit 18 is connected between the positive output line L5 and the positive output terminal 10, the current on the positive output line L5 is compared with the aforementioned reference current.

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Please replace paragraph [0135] with the following amended paragraph:

[0135] First, how this switching power supply apparatus controls its output voltage will be described. When the voltage between the positive and negative output terminals 10 and 11 increases, the output voltage detection circuit 12 compares the voltage obtained from the output voltage division circuit composed of the resistors 12c and 12d with a reference voltage previously set in the shunt

regulator 12a. As a result, the output voltage detection circuit 12 increases the currents through the photodiode ~~13a~~113a and the phototransistor 13b of the photocoupler 13 and thereby increases the voltage at the node between the phototransistor 13b and the resistor 37.

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Please replace paragraph [0137] with the following amended paragraph:

**[0137]** On the other hand, when the voltage between the positive and negative output terminals 10 and 11 decreases, the output voltage detection circuit 12, as a result of a similar comparison operation as described above, decreases the currents through the photodiode ~~13a~~113a and the phototransistor 13b and thereby decreases the voltage at the node between the emitter of the phototransistor 13b and the resistor 37.

Pages 47-48

Please replace paragraph [0144] with the following amended paragraph:

**[0144]** Here, when the switching power supply apparatus starts to start up, its output voltage is zero volts or a low level. Accordingly, the output voltage detection circuit 12 feeds no

current to the photodiode ~~13a~~113a, and thus no current flows through the phototransistor 13b. Hence, as described above, the transistor 38 is turned on by the charge current of the capacitor 41, so that oscillation is continued.